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(54) **OPTICAL BEAM SCANNING DEVICE AND IMAGE FORMING APPARATUS**

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(57) **ABSTRACT**

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An optical beam scanning device is configured from a deflecting unit that has a function to support a deflecting member and a light source, including an exposing semiconductor laser, a polygon mirror, a first fθ lens and a second fθ lens, and strictly regulate their position relative to each other; and a support member that has a function to support a mirror, a second cylindrical lens and a BD sensor along with the deflecting unit, and appropriately position them relative to a photoreceptor drum; and a housing that has a function to cover the outer portion of the deflecting unit and the support member, along with strengthening the support member.

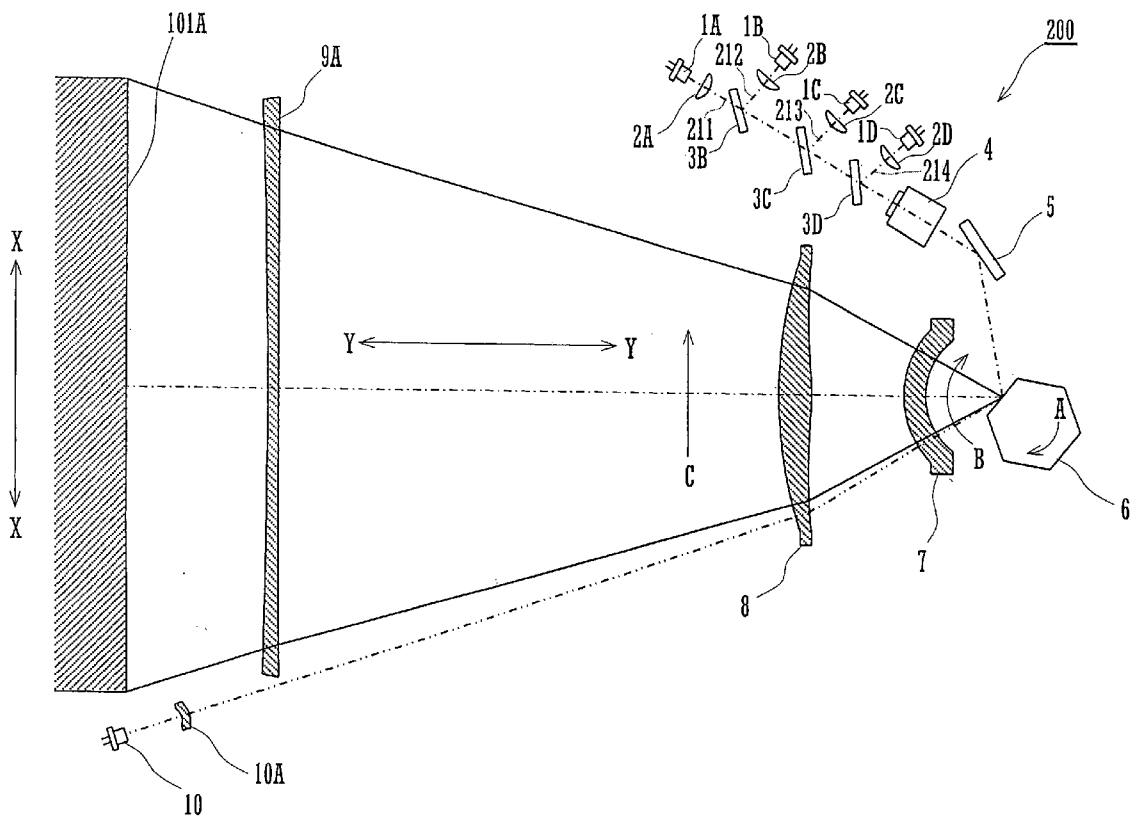
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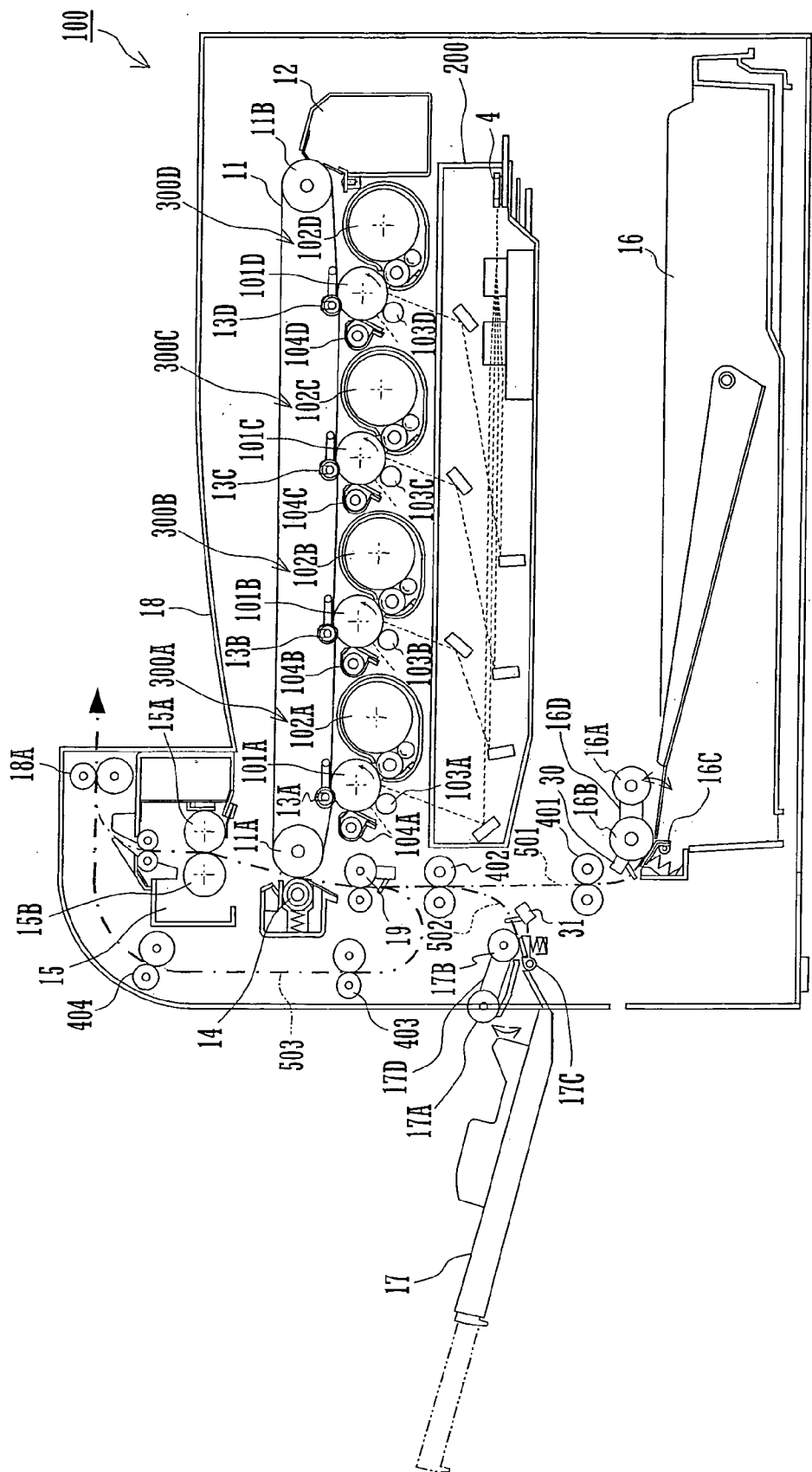


FIG. 1

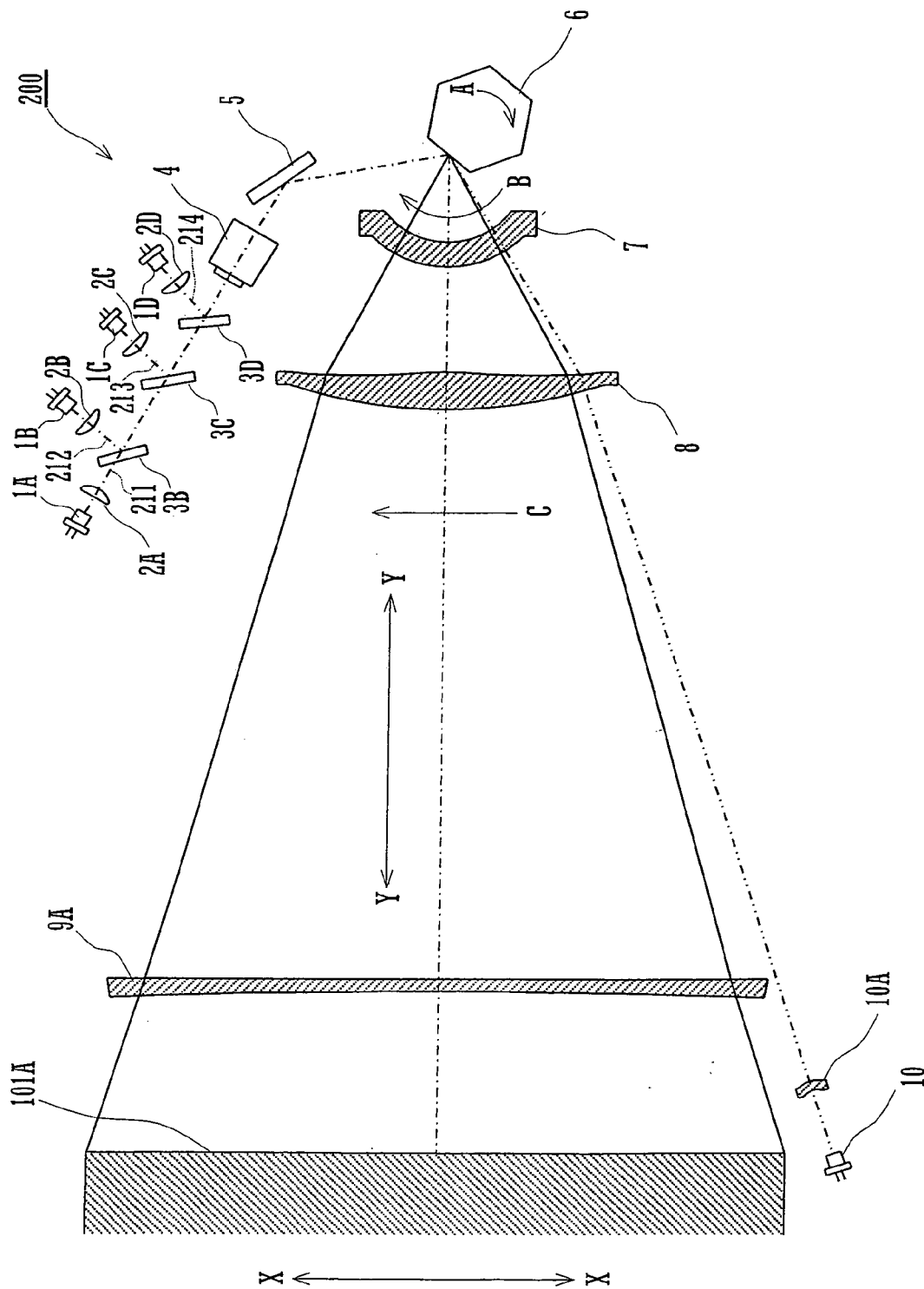


FIG. 2

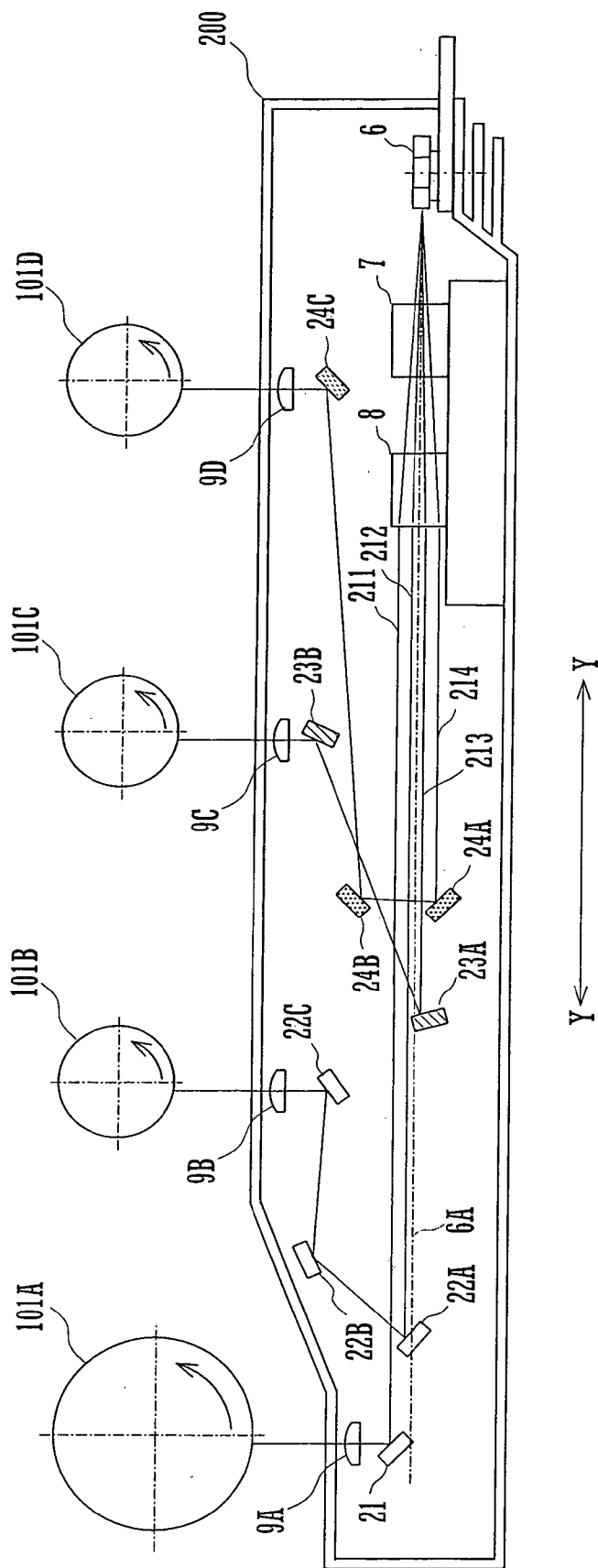


FIG. 3

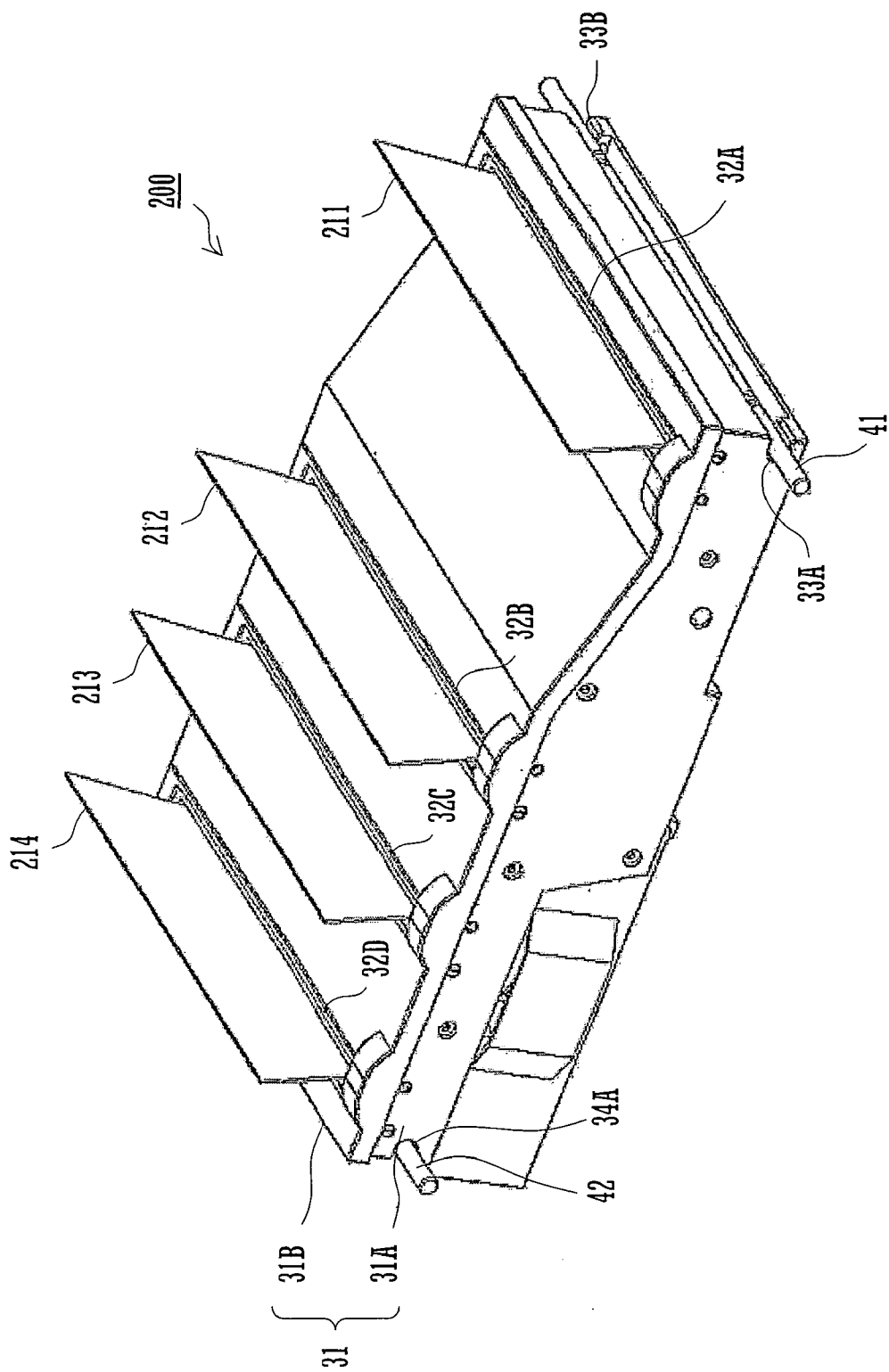


FIG. 4

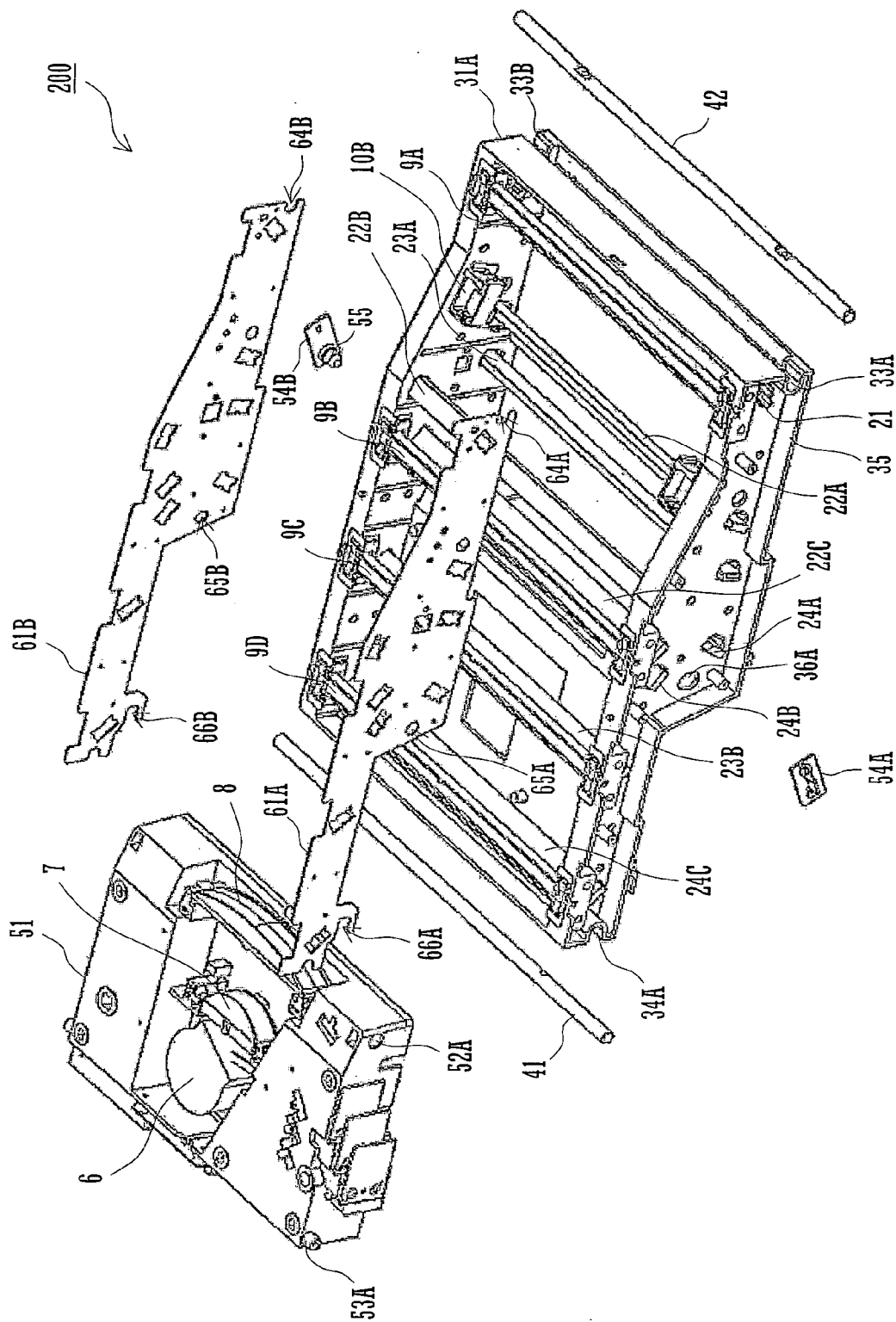


FIG. 5

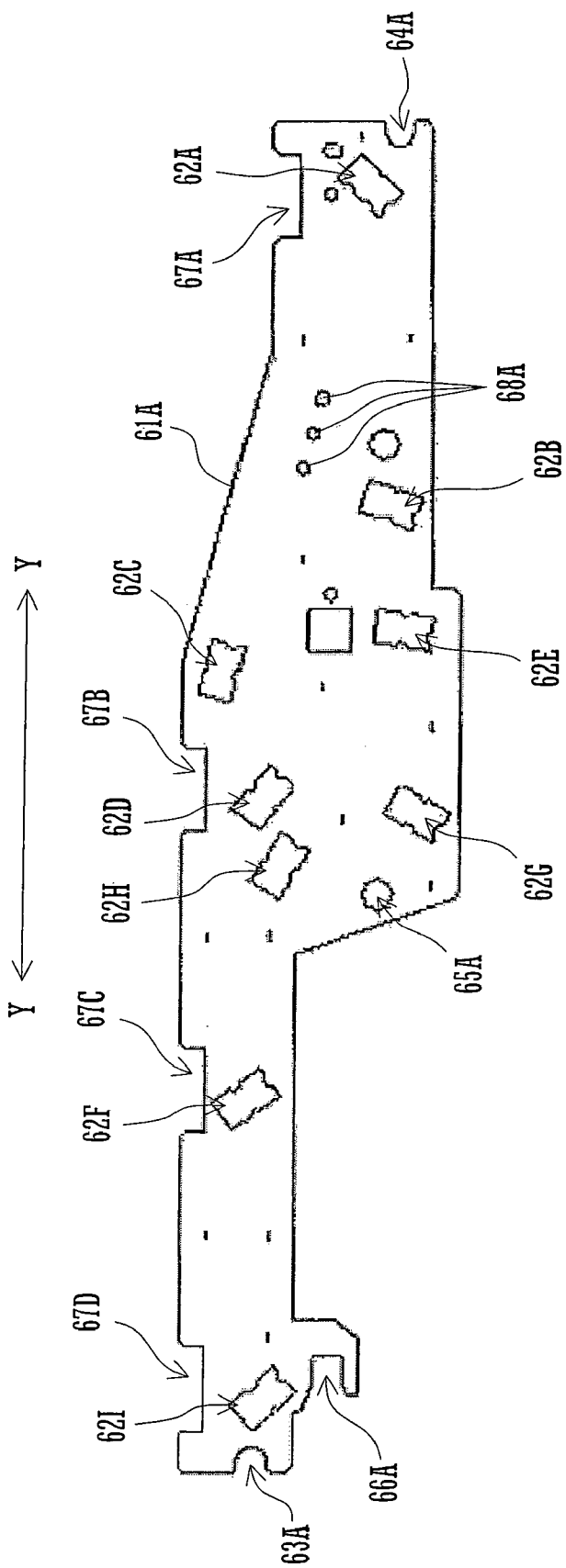


FIG. 6

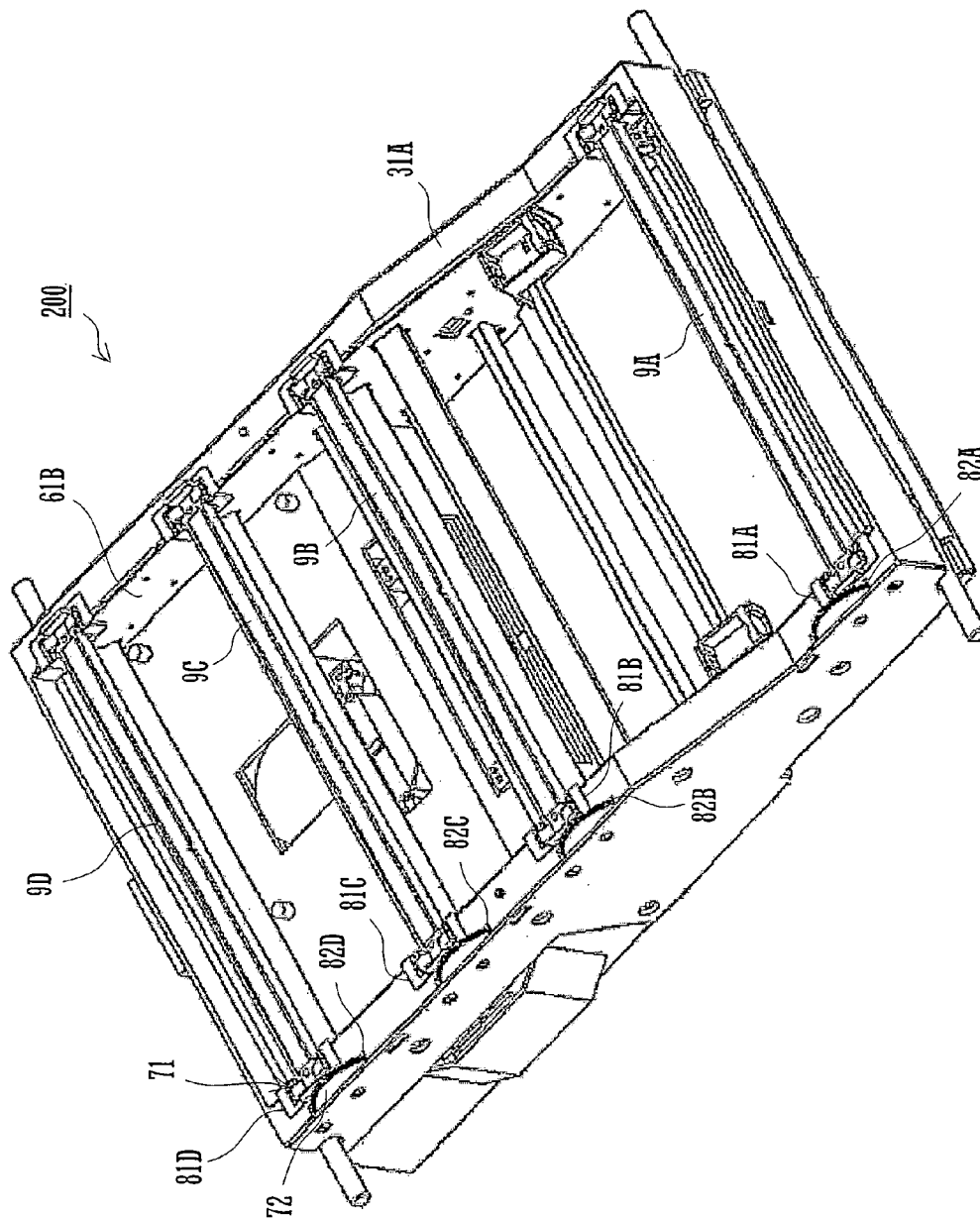


FIG. 7

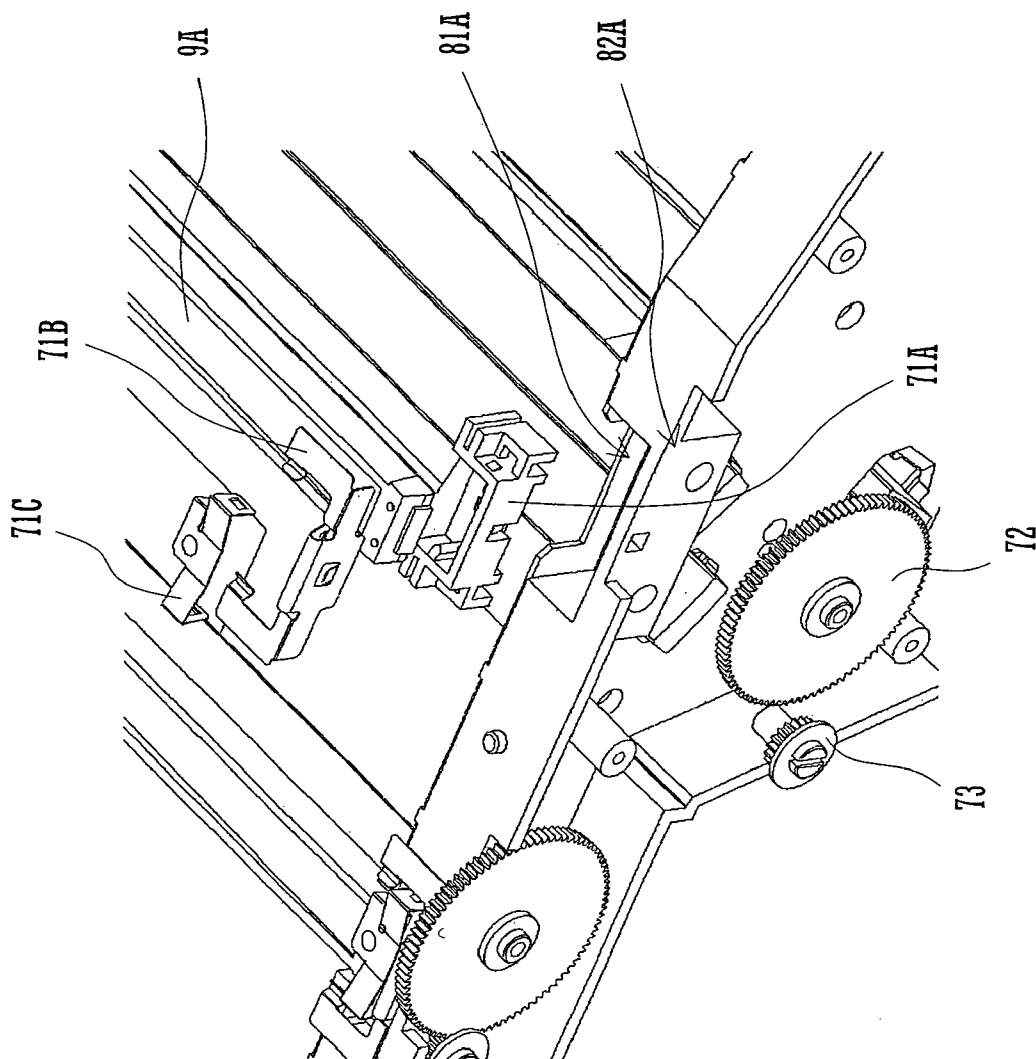


FIG. 8

OPTICAL BEAM SCANNING DEVICE AND IMAGE FORMING APPARATUS

CROSS REFERENCE

[0001] This Nonprovisional application claims priority under 35 U.S.C. § 119 (a) on Patent Application No. 2004-275827 filed in Japan on Sep. 22, 2004, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to an optical beam scanning device that irradiates image light modulated by a signal based on image data to the surface of an image bearing member, used in an image forming apparatus such as a printer, facsimile, copy machine, or the like that performs electrophotographic image formation, and an image forming apparatus provided with this optical beam scanning device.

[0003] As an optical beam scanning device of an image forming apparatus, laser beam systems are widely used that make laser light, which has a fast modulation speed and can increase scanning speed, into image light.

[0004] In recent years, conversion of image forming apparatuses to color has been advancing, and various optical beam apparatuses for color image formation have been developed. Conventional optical beam scanning devices for color image formation have been provided one for each component color, and an optical beam scanning device must be disposed in the image forming apparatus for each color, and along with increased size of the image forming apparatus, expensive optical parts are redundantly provided, leading to increased cost.

[0005] Accordingly, as disclosed in JP 2001-235699A and JP 2001-281587A, technology has been proposed wherein multiple laser light sources for each component color are provided in a single optical beam scanning device. In this optical beam scanning device, mirrors for each component color are housed along with laser light sources for each component color, a single polygon mirror, and a single f θ lens in a single housing, and after the light beam emitted from each laser light source is deflected at a constant angular velocity by the single polygon mirror and deflected at a constant velocity by the single f θ lens, it is separated and dispersed toward the image bearing member for each component color via the mirror provided for each component color.

[0006] However, in the optical beam scanning devices disclosed in JP 2001-235699A and JP 2001-281587A, the mirrors for each component color, the laser light sources, the polygon mirror, and the f θ lens are housed in a single housing, therefore leading to the problem of increased size of the apparatus.

[0007] In order to prevent the deterioration of color image quality due to the occurrence of color shift, it is necessary to strictly maintain the relative position of optical parts such as the laser light sources, polygon mirror, f θ lens, and mirrors, and their position relative to the image bearing members, and the influence of environmental conditions on the optical beam scanning device, particularly changes in temperature, must be made small.

[0008] Thus, using expensive and heavy resin material with a small coefficient of linear expansion such as BMC (Bulk Molding Compound) for the material of the housing, which is a large member that supports all of the optical parts, leads to a jump in the cost of parts and increased weight.

[0009] This sort of problem occurs not only in an optical beam scanning device used in a color image forming apparatus that forms a color image, but also in an optical beam scanning device used in an image forming apparatus that forms a monochrome image.

[0010] It is an object of this invention to provide an optical beam scanning device that can realize lower cost and weight by reducing the amount of expensive and heavy materials used as much as possible, and to provide an image forming apparatus provided with that optical beam scanning device.

SUMMARY OF THE INVENTION

[0011] As a member that supports a light source that constitutes optical parts for allowing an optical beam to scan a scanning target, a deflecting member, and a reflecting member, this invention is provided with a deflecting unit that has a function for holding the light source and the deflecting member, and a support member that has a function for supporting the deflecting unit and the reflecting member. The light source and the deflecting member are integrally held in the deflecting unit while maintaining their position relative to each other, and in the support member, the deflecting unit and the reflecting member are supported while preserving the position of the light source and the deflecting member relative to the reflecting member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is an explanatory diagram that shows a simple configuration of the image forming apparatus 100 provided with an optical beam scanning device according to an embodiment of this invention.

[0013] FIG. 2 is a schematic front view that shows the configuration of the exposing unit 200 that is an optical beam scanning device according to an embodiment of this invention.

[0014] FIG. 3 is a schematic diagram that shows the optical path of the optical beam in the exposing unit 200.

[0015] FIG. 4 is an exterior view from diagonally upward of the back side of the exposing unit 200.

[0016] FIG. 5 is an assembly diagram from diagonally upward of the back side that shows the internal structure of the exposing unit 200.

[0017] FIG. 6 is a front view of a support member provided in the exposing unit 200.

[0018] FIG. 7 is a perspective view from diagonally upward of the back side showing the opened state of the exposing unit 200.

[0019] FIG. 8 is a diagram that shows the configuration of the adjusting member used in the exposing unit 200.

DESCRIPTION OF THE INVENTION

[0020] FIG. 1 is an explanatory diagram that shows a simple configuration of an image forming apparatus 100

provided with an optical beam scanning device according to an embodiment of this invention. The image forming apparatus **100**, which is the main apparatus, forms a multi-color or monochrome image on paper based on image data sent via a network or the like. Thus, the image forming apparatus **100** includes an exposing unit **200**, photoreceptor drums **101A** to **101D**, developing apparatuses **102A** to **102D**, charging rollers **103A** to **103D**, cleaning units **104A** to **104D**, an intermediate transfer belt **11**, first transfer rollers **13A** to **13D**, a second transfer roller **14**, a fixing apparatus **15**, paper transport paths **501** through **503**, a paper supply cassette **16**, a manual paper supply tray **17**, and a receiving tray **18**.

[0021] The image forming apparatus **100** performs image formation in image forming portions **300A** through **300D** using image data corresponding to the hues of the four colors cyan, magenta, and yellow, which are the three subtractive primary colors obtained by color separation of a color image, and black. The image forming portions **300A** through **300D** are given a configuration similar to each other. For example, the black image forming portion **300A** is provided with the photoreceptor drum **101A**, the developing apparatus **102A**, the charging roller **103A**, the transfer roller **13A**, and the cleaning unit **104A**. The image forming portions **300A** through **300D** are arranged in a line in the direction of movement of the intermediate transfer belt **11** (the sub scanning direction perpendicular to the main scanning direction which is the scanning direction of the present invention).

[0022] However, although not shown in **FIG. 1**, the photoreceptor drum **101A** is made to have a large diameter in comparison to the photoreceptor drums **101B** through **101D**. With monochrome image formation performed using only the black image forming portion **300A**, there are high requirements for faster speed, and frequency of use is higher than for color image formation performed using all of the image forming portions **300A** through **300D**. Thus, the reason for the larger diameter is that it is necessary to make the lifetime of the photoreceptor drum **101A** provided in the black image forming portion **300A** longer than that of the photoreceptor drums **101B** through **101D**. The photoreceptor drums **101B** through **101D** are made to have the same diameter. Thus, the space between the rotation axle of the photoreceptor drum **101A** and the rotation axle of the photoreceptor drum **101B** is longer than the space between the rotation axles of the respective photoreceptor drums **101B** through **101D**.

[0023] The charging roller **103** is a contact charger that charges the surface of the photoreceptor drum **101**, which is an image bearing member as the scanning target of this invention, to a uniform potential. A contact charger using a charging brush or a non-contact charger using a charging charge may be used in place of the charging roller **103**.

[0024] The exposing unit **200**, which is the optical beam scanning device of this invention, includes not-shown laser diodes, a polygon mirror **4**, and reflecting mirrors, and irradiates laser beams (the optical beam of this invention) respectively modulated according to image data of the respective hues black, cyan, magenta and yellow to the respective photoreceptor drums **101A** to **101D**. Electrostatic latent images according to the image data of the hues black, cyan, magenta, and yellow are formed on the respective photoreceptor drums **101A** to **101D**. The exposing unit **200** is explained in detail below.

[0025] The developing apparatuses **102A** to **102D** supply toner to the respective surfaces of the photoreceptor drums **101A** to **101D** on which the electrostatic latent images are formed, and develops the electrostatic latent images into developer images. The respective developer apparatuses **102A** to **102D** store toner of the respective hues black, cyan, magenta, and yellow, and develop the electrostatic latent image of the respective hues formed on the respective photoreceptor drums **101A** to **101D** into a developer image of the respective hues black, cyan, magenta, and yellow. The cleaning units **104A** to **104D** remove/collect toner remaining on the surfaces of the photoreceptor drums **101A** to **101D** after developing/image transfer.

[0026] The intermediate transfer belt **11** is stretched between a driving roller **11A** and a driven roller **11B**, forming a loop-shaped movement path. The circumferential surface of the intermediate transfer belt **11** faces the photoreceptor drum **101D**, the photoreceptor drum **101C**, the photoreceptor drum **101B**, and the photoreceptor drum **101A**, in this order. The first transfer rollers **13A** to **13D** are arranged in respective positions sandwiching the intermediate transfer belt **11** and facing the photoreceptor drums **101A** to **101D**. The respective positions where the intermediate transfer belt **11** faces the photoreceptor drums **101A** through **101D** are first transfer positions.

[0027] In order to transfer the developer images carried on the surface of the photoreceptor drums **101A** to **101D** onto the intermediate transfer belt **11**, a first transfer bias with polarity opposite to the charging polarity of the toner is applied to the first transfer rollers **13A** to **13D** by a constant voltage control. Thus, the developer image of each hue formed on the photoreceptor drums **101A** to **101D** is sequentially layered and transferred onto the outer peripheral surface of the intermediate transfer belt **11**, and a full color developer image is formed on the circumferential surface of the intermediate transfer belt **11**.

[0028] However, when image data for only some of the hues yellow, magenta, cyan, and black has been input, formation of the electrostatic latent images and developer images is performed only on some of the photoreceptor drums among the four photoreceptor drums **101A** to **101D** corresponding to the hue of the input image data. For example, when forming a monochrome image, formation of an electrostatic latent image and developer image is performed only on the photoreceptor drum **101A** corresponding to the black hue, and only a black developer image is transferred to the circumferential surface of the intermediate transfer belt **11**.

[0029] Each of the first transfer rollers **13A** to **13D** is configured with an axle of metal material (for example, stainless steel) with a diameter of 8 to 10 mm whose surface is covered in electrically conductive elastic material (such as EPDM: or urethane foam, for example), and with this electrically conductive elastic material a uniform high voltage is applied to the intermediate transfer belt **11**.

[0030] The developer image transferred to the circumferential surface of the intermediate transfer belt **11** at each first transfer position is transported to a second transfer position (corresponding to the transfer position of the present invention), which is a position facing the second transfer roller **14**, by rotation of the intermediate transfer belt **11**. When performing image formation, the second transfer roller **14** is

pressed against the circumferential surface of the intermediate transfer belt **11**, whose internal circumferential surface makes contact with the circumferential surface of the driving roller **11A**, with a predetermined nip pressure.

[0031] When the paper (the recording medium of this invention) supplied from the paper supply cassette **16** or the manual supply tray **17** passes between the second transfer roller **14** and the intermediate transfer belt **11**, high voltage with a polarity opposite to the toner charging polarity is applied to the secondary transfer roller **14**. Thus, the developer image is transferred from the circumferential surface of the intermediate transfer belt **11** to the surface of the paper.

[0032] Among the toner affixed to the intermediate transfer belt **11** from the photoreceptor drums **101A** to **101D**, toner that remains on the intermediate transfer belt **11** without being transferred onto the paper is recovered by a cleaning unit **12**, in order to prevent color mixture in the following process.

[0033] The paper onto which a developer image has been transferred is guided to the fixing apparatus **15**, and receives heat and pressure by passing between a heat roller **15A** and a pressure roller **15B**. Thus, the developer image is strongly fixed to the surface of the paper. The paper to which the developer image has been fixed is discharged onto the discharge tray **18** by a discharge roller **18A**.

[0034] In the image forming apparatus **100**, a paper transport path **501** is provided in an approximately perpendicular direction for feeding paper housed in the paper supply cassette **16**, between the second transfer roller **14** and the intermediate transfer belt **11** and then via the fixing apparatus **15**, to the discharge tray **18**. The paper transport path **501** in the interval from the paper supply cassette **16** to the second transfer position corresponds to the paper transport path of this invention.

[0035] Arranged in the paper transport path **501** are a pickup roller **16A** that carries out the paper in the paper supply cassette **16** one by one, a paper supply roller **16B**, a separating pad **16C** that separates paper such that only the paper in the uppermost position is transported when multiple sheets of paper have been carried out in a stack, and transport rollers **401** and **402**, for which the rotational speed at which paper carried out is transported along the paper transport path **501** can be changed.

[0036] Immediately after the separating pad **16C** of the paper transport path **501**, a paper detector **30** is disposed. The paper detector **30** detects the presence or absence of the paper that passes between the paper supply roller **16B** and the separating pad **16C**. That is, it detects whether or not one sheet of paper has been appropriately carried out from the paper supply cassette **16** to the paper transport path **501** by the pickup roller **16A**. Also, the paper detector **30** outputs the detection results to a connected control portion **50**.

[0037] Arranged in the paper transport path **501** are a register roller **19** that guides the transported paper between the secondary transfer roller **14** and the intermediate transfer belt **11** at a predetermined timing, and a discharge roller **18A** that discharges the paper to the discharge tray **18**.

[0038] Also, a paper transport path **502** is formed in the image forming apparatus **100** in the interval from the manual paper supply tray **17** to the register roller **19**. Similar to the

configuration of the paper transport path **501**, a pickup roller **17A** that carries out recording paper placed in the manual paper supply tray **17** one by one into the paper supply path **502**, a paper supply roller **17B**, and a separating pad **17C** are arranged in the paper transport path **502**.

[0039] Further, a paper transport path **503** is formed in the interval from the discharge roller **18A** to the upstream side of the register roller **19** in the paper transport path **501**. The discharge roller **18A** is made rotatable in both the forward and reverse directions, and is driven in the direction of frontward rotation and discharges the paper to the discharge tray **18** when simplex printing is performed that forms an image on one side of the paper, or when performing image formation for the second face in duplex image formation that forms an image on both sides of the paper.

[0040] On the other hand, when performing image formation for the first face in duplex image formation, after being driven in the direction of frontward rotation until the trailing edge of the paper passes the fixing apparatus **15**, the discharge roller **18A** is driven in the direction of reverse rotation in a state sandwiching the trailing edge of the paper, and guides the paper into the paper transport path **503**. Thus, paper on which an image has been formed on only one side when performing duplex image formation is guided to the paper transport path **501** in a state in which the front and back sides and the leading and trailing edges are reversed.

[0041] The register roller **19** guides paper that has been supplied from the paper supply cassette **16** or the manual paper supply tray **17**, or transported via the paper transport path **503**, between the secondary transfer roller **14** and the intermediate transfer belt **11** at a timing synchronous with the rotation of the intermediate transfer belt **11**. Thus, the register roller **19** stops rotating at the time that the operation of the photoreceptor drums **101A** to **101D** and the intermediate transfer belt **11** begins, and paper supplied or transported before rotation of the intermediate transfer belt **11** stops moving in the paper transport path **501** in a state in which the leading edge is caught by the register rollers **19**.

[0042] Afterwards, the register rollers **19** begin rotation at the timing that the leading edge of the paper and the leading edge of the developer image formed on the intermediate transfer belt **11** face each other at the position where the secondary transfer roller **14** and the intermediate transfer belt **11** press together.

[0043] When full color image formation is performed, in which an image is formed in all of the image forming portions **300A** to **300D**, the first transfer rollers **13A** to **13D** press the intermediate transfer belt **11** against all of the photoreceptor drums **101A** to **101D**. On the other hand, when monochrome image formation is performed, in which an image is formed in only the image forming portion **300A**, only the first transfer roller **13A** presses the intermediate transfer belt **11** against the photoreceptor drum **101A**.

[0044] FIG. 2 is a schematic front view that shows the configuration of the exposing unit **200** that is an optical beam scanning device according to an embodiment of this invention. FIG. 3 is a schematic diagram that shows the optical path of the optical beam in the exposing unit **200**. The laser beam scanning direction in the direction of the arrow X-X in FIG. 2, which is the direction parallel to the rotational axis of the photoreceptor drum **101A**, is the

scanning direction of this invention, referred to below as the main scanning direction. The direction of the arrow Y-Y in FIG. 3, which is the direction perpendicular to the main scanning direction inside a main optical axis plane 6A, is referred to as the sub scanning direction.

[0045] The exposing unit 200 is provided with optical parts including laser diodes 1A to 1D, collimator lenses 2A to 2D, mirrors 3B to 3D, a first cylindrical lens 4, a mirror 5, a polygon mirror 6, a first f θ lens 7, a second f θ lens 8, second cylindrical lenses 9A to 9D, mirrors 21 to 24, a synchronizing lens 10A, and a BD (Beam Detective) sensor 10.

[0046] The laser diodes 1A to 1D, which are the light sources of this invention, irradiate laser beams 211 to 214, which are modified based on the image data for black, cyan, magenta, and yellow, respectively. The laser beams 211 to 214 are a plurality of optical beams of this invention. The respective laser beams 211 to 214, which are diffused light irradiated from the laser diodes 1A to 1D, are incident on the reflecting surface of the polygon mirror 6 via the collimator lenses 2A to 2D, the mirrors 3B to 3D, the first cylindrical lens 4, and the mirror 5, at mutually differing angles of incidence in a horizontal plane that includes the rotational axis of the polygon mirror 6.

[0047] The polygon mirror 6 is provided with six reflective surfaces, as one example. The polygon mirror 6 rotates in the direction of the arrow A, and deflects the laser beams 211 through 214 at each reflective surface at a constant angular velocity in the direction of the arrow B.

[0048] The first f θ lens 7 and the second f θ lens 8 deflect the laser beams 211 to 214, deflected at a constant angular velocity by the polygon mirror 6 in the main scanning direction (the scanning direction of this invention) parallel to the axial direction of the photoreceptor drums 101A to 101D on the surface of the respective photoreceptor drums 101A to 101D, at a constant velocity in the direction of the arrow C. As an example, the first f θ lens 7 is configured with both an incident face and a light exiting face being aspherical surfaces. And, the second f θ lens 8 is configured from an incident face that is made a free-curved surface, and a light exiting face that is made an aspherical surface.

[0049] The polygon mirror 6, the first f θ lens 7, and the second f θ lens 8 are the deflecting members of this invention.

[0050] The mirrors 21 to 24 are the reflecting members of this invention, and separate and reflect the laser beams 211 to 214 such that they are distributed on the surface of the respective photoreceptor drums 101A to 101D. That laser beams 211 to 214 that have passed the second f θ lens 8 each form images on the respective photoreceptor drums 101A to 101D via the mirror 21 and the second cylindrical lens 9A, the mirrors 22A to 22C and the second cylindrical lens 9B, the mirrors 23A and 23B and the second cylindrical lens 9C, and the mirrors 24A to 24C and the second cylindrical lens 9D. The second cylindrical lenses 9A to 9D are the optical members of this invention.

[0051] The optical path of the laser beams 211 to 214 shown in FIG. 3 differs from the actual optical path in the exposing unit 200 shown in FIG. 4 and subsequent figures. Specifically, in FIG. 3 the black laser beam 211 is positioned

below the cyan laser beam 212, but in FIG. 4 and the subsequent figures the laser beam 211 is positioned above the laser beam 212.

[0052] After passing the second f θ lens 8, the laser beams 211 and 212 and the laser beams 213 and 214 are deflected in vertically positioned planes that are parallel to the deflection plane 6A and sandwich the deflection plane 6A. The deflection plane 6A is a horizontal plane that includes the normal direction of each reflective face of the polygon mirror 6.

[0053] In the first f θ lens 7, both the incident face and the light exiting face are aspherical surfaces, and in the second f θ lens 8 the incident face is made an aspherical surface, and the light exiting face is made a free-curved surface. In consideration of the ability for mass production, the first f θ lens 7, the second f θ lens 8, and the second cylindrical lens 9 use parts made of plastic, but lenses made of glass may also be used.

[0054] The BD sensor 10 is the light receiving member of this invention, and detects any of the laser beams 211 to 214 outside of the effective exposing region in the main scanning direction. That is, in a range that any of the laser beams 211 to 214 reflected by a reflective face of the polygon mirror 6 do not reach the surface of the photoreceptor drums 101A to 101D in the main scanning direction, the laser beams 211 to 214 form an image on the light receiving surface of the BD sensor 10 via the synchronous lens 10A. When light has been received from any of the laser beams 211 to 214, a signal is output in order to determine the modulation start timing (the scan timing of this invention) from the image data of the laser beams 211 to 214 of the laser diodes 1A to 1D.

[0055] Because the laser beams 211 to 214 are reflected such that all of the laser beams are approximately superimposed at the identical reflecting faces of the polygon mirror 6, it is possible to control the modulation start timing of all of the laser beams with just one laser beam. Because detection is performed by the BD sensor 10 using the laser beam 211 that forms a black image, which has the smallest curve distortion of the scanning line, highly precise detection is possible.

[0056] FIG. 4 is an exterior view from diagonally upward of the rear side of the exposing unit 200. The exposing unit 200 constitutes an outer surface with a housing 31 that includes a main housing body 31A and a housing lid 31B. As an example, the main housing body 31A and the housing lid 31B are made of inexpensive and lightweight resin that has a comparatively large coefficient of linear expansion, such as a polycarbonate in which glass fiber is mixed (the coefficient of linear expansion for a polycarbonate with a 30% mixture of glass fiber is $2.7 \times 10^{-5}/^{\circ}\text{C}$.).

[0057] The reason for using inexpensive and lightweight resin as the material for the housing 31 is that the housing 31 itself does not support other members, and has purposes such as blocking light from the interior of the exposing unit 200 and dust protection.

[0058] In the housing lid 31B, slits 32A to 32D are formed in the main scanning direction (the direction of arrow X-X) facing the respective photoreceptor drums 101A to 101D (not shown). The laser beams 211 to 214 are irradiated via the slits 32A to 32D toward the photoreceptor drums 101A to 101D.

[0059] The height of the exposing unit **200**, in the portion facing the photoreceptor drum **101A**, is less than the portion facing the other photoreceptor drums **101B** to **101D**. This is because the photoreceptor drum **101A** has a large diameter in comparison to the photoreceptor drums **101B** to **101D**, and it is necessary to make the bottom face of the exposing unit **200** approximately horizontal in order to avoid interference with other units inside of the image forming apparatus **100**. When the photoreceptor drums **101A** to **101D** have the same diameter, the height of the exposing unit **200** can be made approximately uniform across its entire width.

[0060] Concave portions **33A** and **33B** and concave portions **34A** and **34B**, open to the outside in the left and right directions, are formed in at least the front and back sides of the left and right sides of the main housing body **31A** (however, concave portion **34B** is not shown in FIG. 4). The concave portions **33A** and **33B** and concave portions **34A** and **34B** are respectively fit to axle bodies **41** and **42**, both ends of which are fixed to the front side frame and back side frame of the image forming apparatus **100** (not shown). The width of the concave portions **33A** and **33B** and concave portions **34A** and **34B** in the vertical direction is made larger than the outer diameter of the axle bodies **41** and **42**.

[0061] Also, with respect to the sub scanning direction (the direction of the arrow Y-Y), the space between the center of the circular arc portion of the concave portions **33A** and **33B**, and the center of the circular arc portion of the concave portions **34A** and **34B** is made shorter than the distance between the center of the axle body **41** and the center of the axle body **42**. Thus, for at least either the concave portions **33A** and **33B** or the concave portions **34A** and **34B**, only the upper surface contacts the peripheral surface of the axle bodies **41** and **42**.

[0062] FIG. 5 is an assembly diagram from diagonally upward of the rear side that shows the internal structure of the exposing unit **200**. Inside the housing **31** are contained the mirror **21**, the mirrors **22A** to **22C**, the mirrors **23A** and **23B**, the mirrors **24A** to **24C**, the second cylindrical lenses **9A** to **9D**, and the BD sensor **10**, in a state supported by support members **61A** and **61B** positioned on the front and back sides of the image forming apparatus **100**. On one side in the sub scanning direction on the bottom face of the housing **31**, a deflection unit **51** is disposed that holds the laser diodes **1A** to **1D**, the collimator lenses **2A** to **2D**, the mirrors **3B** to **3D**, the first cylindrical lens **4**, the mirror **5**, the polygon mirror **6**, the first f θ lens **7**, and the second f θ lens **8**, in a state supported by the support members **61A** and **61B**.

[0063] The deflection unit **51** is, for example, formed from strong material with a low coefficient of linear expansion such as BMC (the coefficient of linear expansion for BMC is $1.8 \times 10^{-5}/^{\circ}\text{C}$). In the deflection unit **51**, the laser diodes **1A** to **1D**, the collimator lenses **2A** through **2D**, the mirrors **3B** to **3D**, the first cylindrical lens **4**, the mirror **5**, the polygon mirror **6**, the first f θ lens **7**, and the second f θ lens **8** are positioned in a state in which their position relative to each other is strictly regulated.

[0064] The front side and back side support members **61A** and **61B** are formed in a predetermined shape by perforation processing a rolled steel plate with a thickness of 0.8 mm to 1.2 mm. Even with processing for a plate material such as a rolled steel plate, distortion easily occurs due to dimensional tolerance and internal stress in the bending process, it is

difficult to properly position each part in the respective support members **61A** and **61B**, and it is also difficult to make the dimensions between the support member **61A** and the support member **61B** uniform. On the other hand, with perforation processing that sandwiches the plate material between metal dies, the metal die precision is reflected repeatedly in multiple finished goods, and it is possible to make the dimensions between the support portion **61A** and the support portion **61B** uniform.

[0065] FIG. 6 is a front view of the support member **61A** provided in the exposing unit **200**. Inside the support member **61A**, which is a plate wherein the sub scanning direction (the direction of arrow Y-Y) is made the lengthwise direction, mirror support portions **62A** to **62I** are formed in the shape of a square cavity. The mirror support portions **62A** to **62I** support the respective edges of the mirrors **21**, **22A** to **22C**, **23A**, **23B**, and **24A** to **24C**.

[0066] Lens support portions **67A** to **67D**, which are the optical member support portions of this invention, are formed on the upper edge surface of the support member **61A**. The lens support portions **67A** to **67D** take the form of a rectangular notch, and support the respective edges of the second cylindrical lenses **9A** to **9D** via an adjusting portion (described below).

[0067] A first supported portion **63A** and a second supported portion **64A** are formed on the left and right edge surfaces of the support member **61A**. The supported portion **63A** and the supported portion **64A** are concave portions that are open to the outside in the sub scanning direction. The supported portions **63A** and **64A** are respectively fitted to the axle bodies **41** and **42**, both ends of which are fixed to the front and back side frames of the not-shown image forming apparatus **100**. Thus the support portion **61A** is supported by the frame of the image forming apparatus **100** via the axle bodies **41** and **42**.

[0068] The width of the supported portions **63A** and **64A** in the vertical direction is made larger than the outer diameter of the axle bodies **41** and **42**. Thus, with respect to the sub scanning direction (the direction of the arrow Y-Y), the space between the center of the circular arc portion of the supported portion **63A** and the center of the circular arc portion of the supported portion **64A** is made longer than the distance between the center of the axle body **41** and the center of the axle body **42**. Thus only the upper surface of the supported portions **63A** and **64A** make contact with the peripheral surface of the axle bodies **41** and **42**, and the supported portions **63A** and **64A** are made displaceable only a predetermined distance in the sub scanning direction relative to the axle bodies **41** and **42**.

[0069] A fixing cavity **65A** is formed in approximately the center portion of the support member **61A** in the sub scanning direction. A rectangular concave portion **66A** is formed in the lower edge surface of the support portion **61A** in the neighborhood of the edge in the left side of the figure. The fixing cavity **65A** and the concave portion **66A** are the first and second unit support portions of this invention. The support member **61A** supports the deflecting unit **51** via the fixing cavity **65A** and the concave portion **66A**.

[0070] Also, a fixing cavity **68A** is formed in the support member **61A**. The fixing cavity **68A** is the light receiving member support portion of this invention. In the fixing

cavity 68A, the fixing portion 10B that supports the BD sensor 10 and the synchronous lens 10A is fixed to the support portion 61A.

[0071] The support member 61B is configured in the same manner as the support member 61A.

[0072] As shown in FIG. 5, installation holes 52A and 52B are formed in the front and back surfaces of the deflecting unit 51 in the neighborhood of the edge in the right side of the figure (however, the installation hole 52B is not shown in FIG. 5). Support axles 53A and 53B are formed in the neighborhood of the edge in the left side of the figure (however, support axle 53B is not shown in FIG. 5).

[0073] The support member 61A is housed in the main housing body 31A with the outside wall of the support portion 61A contacting the inside surface of the front and back walls of the main housing body 31A, in a state in which the mirrors 21, 22A to 22C, 23A, 23B, and 24A to 24C, the second cylindrical lenses 9A to 9D, and also the BD sensor and the synchronous lens 10A are supported at each support portion.

[0074] The concave portion 66A is open to the left side in the figure, and its width in the vertical direction is made larger than the radius of the support axle 53. Also, with respect to the sub scanning direction (the direction of the arrow Y-Y), the length of the concave portion 66A is made longer than the outer diameter of the support axle 53. Thus, only the upper surface of the concave portion 66A contacts the peripheral surface of the support axle 53, and the support axle 53 is made displaceable only a predetermined distance in the sub scanning direction relative to the concave portion 66A.

[0075] A protruding rib 35 is formed protruding from the front and rear walls of the main housing body 31A across the entire periphery. Thus, the front and rear walls of the main housing body 31A are made stronger in comparison to other parts. Accordingly, the support portion 61A is reinforced by the walls of the main housing body 31A in the main scanning direction, which is the direction of thickness.

[0076] After housing the support portion 61A in the main housing body 31A, the deflecting unit 51 is inserted from the left side in FIG. 5 in the downward direction of the main housing body 31A. When the support portion 61A is housed in the main housing body 31A, the fixing cavity 64 of the support portion 61A faces the installation cavity 36 of the main housing body 31A. When the support axle 53 of the deflecting unit 51 has been fitted into the concave portion 66A of the support member 61A, the installation hole 52A of the deflection unit 51 faces the fixing cavity 36A of the main housing body 31A and the fixing cavity 64A of the support portion 61A.

[0077] In this state an axle portion 55 of a fixing portion 54B is made to penetrate in sequence from the outside of the main housing body 31A through the fixing cavity 36A and the fixing cavity 64A, and is fitted in the installation hole 52A. Thus, the support member 61A, the main housing body 31A, and the deflecting unit 51 are positioned at one point in the sub scanning direction. A fixing portion 54A has a not-shown axle portion that is similar to the axle portion 55 of the fixing portion 54B.

[0078] The axle portion 55 is configured with three portions of mutually varying diameters disposed on the same

axle. The axle portion 55 fits with three respective portions of the installation cavity 36 of the main housing body 31A, the fixing cavity 64A of the support portion 61A, and the installation hole 52A of the deflection unit 51. Accordingly, the main housing body 31A and the deflecting unit 51 transform independently of each other, and transformation occurring in the main housing body 31A does not affect the position of the deflecting unit 51.

[0079] The above description of the support member 61A is also the same for the support member 61B, and the support member 61B is housed in the main housing body 31A in the same manner as the support member 61A.

[0080] FIG. 7 is a perspective view from diagonally upward of the back side showing the opened state of the exposing unit 200. FIG. 8 is a diagram that shows the configuration of the adjusting member used in the exposing unit 200. The second cylindrical lenses 9A to 9D are arranged in the uppermost portion inside the optical unit 200 assembled in the manner described above. As stated earlier, the second cylindrical lenses 9A to 9D are supported by the lens support portions 67A to 67D that are formed at the upper edge of the support portion 61A by the adjusting portion 71.

[0081] On the top surface of the front of the main housing body 31A, concave portions 81A to 81D are formed at a position facing the respective lens support portions 67A to 67D of the support portion 61A. Also, cavity portions 82A to 82D are formed adjacent to the respective concave portions 81A to 81D. The concave portions 81A to 81D house the adjusting member 71. Part of the adjusting gear 72 is exposed to the top surface from the cavity portions 82A to 82D. The concave portions 81A to 81D that house the adjusting member 71 are similarly formed on the top surface of the back of the main housing body 31A.

[0082] The adjusting member 71 includes a holder 71A, a holder spring 71B, and a lens spring 71C. The edges of the second cylindrical lenses 9A to 9D are housed in the holder 71A via the lens spring 71C. The holder 71A is housed in the concave portions 81A to 81D of the back of the main housing body 31A via the holder spring 71B. The width of each concave portion 81 is longer than the length of the holder 71A in the sub scanning direction.

[0083] The adjusting gear 72 engages with an adjusting gear 73 at the back of the main housing body 31A. Rotation of the adjusting gear 73 is transmitted to the holder 71A housed in the concave portion 81 via a not-show mechanism as linear motion in the sub scanning direction. Thus, by rotating the adjusting gear 72 exposed from the cavity portions 82A to 82D, the edge of the back of the second cylindrical lenses 9A to 9D moves in the sub scanning direction, and tilt of the second cylindrical lens 9 in the upper surface of the exposing unit 200 changes. Thus, tilt of the image light in the scanning direction relative to the surface of the photoreceptor drums 101A to 101D is adjusted.

[0084] In the above manner, the exposing unit 200 according to an embodiment of this invention is configured from a housing 31, a deflecting unit 51, and support members 61A and 61B. The deflecting unit 51, which is made of material that is comparatively heavy and has a small coefficient of linear expansion approaching that of metal, such as BMC,

realizes a function to hold the deflecting member and the light source, which includes laser diodes 1A to 1D, collimator lenses 2A to 2D, mirrors 3B to 3D, the first cylindrical lens 4, the mirror 5, the polygon mirror 6, the first f θ lens 7, and the second f θ lens 8, at strictly regulated positions relative to each other.

[0085] Also, the support members 61A and 61B, formed by perforation processing a flat metal plate, realizes a function that supports the mirrors 21 to 24, the second cylindrical lenses 9A to 9D, and the BD sensor 10 and strictly regulates their position relative to each other, and while supporting the deflecting unit 51 with its position in the vertical direction surely regulated, regulates the position at which these parts in the image forming apparatus 100 are disposed and appropriately positions them relative to the photoreceptor drums 101A to 101D.

[0086] Further, the housing 31, made from comparatively lightweight resin material such as PPT, realizes a function that prevents the intrusion of dust and the like and the incidence of outside light into the space in which the members are held and supported by the deflecting unit 51 and the support members 61A and 61B by covering the outer portion of the deflecting unit 51 and the support members 61A and 61B, and strengthens the support members 61A and 61B.

[0087] Thus, the exposing unit 200 is configured from a plurality of members that each realize different functions, and it is possible to form each portion in a shape appropriate for the function to be realized with materials suitable for the function to be realized by each member.

[0088] That is, support members 61A and 61B used for positioning of the optical parts are formed only from the perforation process of a metal plate that has a small coefficient of linear expansion, and by forming the housing 31, which is a large member used for coating the optical parts and reinforcement of the support members 61A and 61B, from comparatively lightweight resin, it is possible to use comparatively heavy materials such as BMC only for the comparatively small deflecting unit 51 used for positioning of the light source and the deflecting member.

[0089] For example, when the optical parts are supported in the housing, a decrease in the positional precision of the optical parts due to temperature change should be prevented, and it is necessary to configure the housing, which is a large member, from expensive and heavy material such as BMC, leading to increased cost and weight.

[0090] On the other hand, in the exposing unit 200 according to an embodiment of this invention, the housing 31 can be configured from lightweight and inexpensive resin material, and it is possible to realize decreased cost and lighter weight.

[0091] Finally, the embodiments described above are to be considered in all respects as illustrative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing embodiments. Furthermore, all changes which come within the meaning and range of equivalency of the claims are intended to be embraced in the scope of the invention.

1. An optical beam scanning device comprising:

a deflecting unit that holds a light source that irradiates an optical beam and a deflecting member that deflects the optical beam irradiated from the light source at a

constant velocity after the optical beam is deflected at a constant angular velocity in a predetermined deflection plane, the deflecting unit integrally holding the light source and the deflecting member while maintaining their position relative to each other; and

a support member that supports a reflecting member that reflects the optical beam deflected at a constant velocity by the deflecting member toward a scanning target supported by a main apparatus, and also supports the deflecting unit such that the positions of the light source and the deflecting member relative to the reflecting member are preserved, the support member being supported in a predetermined position in the main apparatus,

wherein the optical beam scanning device scans the surface of the scanning target in a predetermined scanning direction with the optical beam irradiated from the light source.

2. The optical beam scanning device according to claim 1,

wherein the support member is a plate disposed respectively on the front side and the back side of the main apparatus, provided with first and second supported portions that are supported by the frame of the main apparatus at two locations in a direction perpendicular to the scanning direction in a plane parallel to the deflection plane, and

wherein at least one of the supported portions is supported by the frame of the main apparatus such that the supported portion is movable in the direction perpendicular to the scanning direction in the plane parallel to the deflection plane.

3. The optical beam scanning device according to claim 2, wherein at least one of the supported portions is fitted to an axle body fixed between the frames of the front side and the back side of the main apparatus in a direction perpendicular to the scanning direction in the plane parallel to the deflection plane.

4. The optical beam scanning device according to claim 1, wherein the support portion is a plate disposed respectively on the front side and the back side of the main apparatus, provided with first and second unit support portions that support the deflecting unit at two locations in a direction perpendicular to the scanning direction in a plane parallel to the deflection plane, and in addition to supporting the deflecting unit at the first unit support portion in a fixed manner, supports the deflecting unit at the second unit support portion such that it can be displaced only in the direction perpendicular to the scanning direction in the plane parallel to the deflecting plane.

5. The optical beam scanning device according to claim 4, wherein at least one of the first and second scanning units in the support member are positioned in the deflection plane.

6. The optical beam scanning device according to claim 1, further comprising a housing that houses the support member and the reflecting member,

wherein the support member is a plate arranged on the front side and the back side of the main apparatus respectively, and

wherein the interior face of the wall of the housing contacts the outer face of the support member, fixing the housing to the support member.

7. The optical beam scanning device according to claim 6, wherein the support member includes a housing holding portion that fixes the housing member at one location in the center portion in the direction perpendicular to the scanning direction in the plane parallel to the deflection plane.

8. The optical beam scanning device according to claim 6, wherein in the housing, at least strength of the wall surface is greater than strength of other surfaces.

9. The optical beam scanning device according to claim 1, wherein the support member is a plate made of the same material as the frame of the main apparatus.

10. The optical beam scanning device according to claim 1, further comprising a light-receiving member that receives the optical beam at a predetermined position and detects the scanning timing of the optical beam,

wherein the support member is a plate and includes a support portion for supporting the light-receiving portion.

11. The optical beam scanning device according to claim 1, further comprising an optical member that allows the optical beam to provide an image on the surface of the scanning target, wherein the support member is a plate and includes a support portion for supporting the optical member by an adjusting member that adjusts the support position.

12. The optical beam scanning device according to claim 1, further comprising a plurality of the light sources and the reflecting members,

wherein a plurality of the scanning targets provided in the main apparatus are each scanned by the plurality of light beams irradiated from the plurality of light sources.

13. The optical beam scanning device according to claim 2, wherein the support member is formed by only perforation processing plate material.

14. An image forming apparatus, comprising:

an image bearing member that carries a developer image developed from an electrostatic latent image, and

an optical beam scanning device including,

a deflecting unit that holds a light source that irradiates an optical beam and a deflecting member that deflects the optical beam irradiated from the light source at a constant velocity after the optical beam is deflected at a constant angular velocity in a predetermined deflection plane, the deflecting unit integrally holding the light source and the deflecting member while maintaining their position relative to each other, and

a support member that supports a reflecting member that reflects the optical beam deflected at a constant velocity by the deflecting member toward a scanning target supported by a main apparatus, and also supports the deflecting unit such that the positions of the light source and the deflecting member relative to the reflecting member are preserved, and is supported in a predetermined position in the main apparatus, wherein the optical beam scanning device scans the surface of the scanning target in a predetermined scanning direction with the optical beam irradiated from the light source,

wherein the optical beam is image light wherein the optical beam has been modulated based on image data, an electrostatic latent image is formed on the image bearing member by the image light irradiated from the optical beam scanning device, and a developer image developed from the electrostatic latent image is transferred from the image bearing member onto a recording medium.

15. The image forming apparatus according to claim 14, further comprising a plurality of image bearing members, and

wherein the optical beam scanning device further comprises a plurality of the light sources and the reflecting members, wherein each of the plurality of image bearing members are scanned by each of the plurality of light beams irradiated from the plurality of light sources, and

wherein an electrostatic latent image is formed on each of the plurality of image bearing members by each of the plurality of image lights irradiated from the optical beam scanning device, and a developer image developed from the electrostatic latent image is superimposed in sequence and transferred from each of the plurality of image bearing members onto the recording medium.

16. The optical beam scanning device according to claim 3, wherein the support member is formed by only perforation processing plate material.

17. The optical beam scanning device according to claim 4, wherein the support member is formed by only perforation processing plate material.

18. The optical beam scanning device according to claim 5, wherein the support member is formed by only perforation processing plate material.

19. The optical beam scanning device according to claim 6, wherein the support member is formed by only perforation processing plate material.

20. The optical beam scanning device according to claim 7, wherein the support member is formed by only perforation processing plate material.

21. The optical beam scanning device according to claim 8, wherein the support member is formed by only perforation processing plate material.

22. The optical beam scanning device according to claim 9, wherein the support member is formed by only perforation processing plate material.

23. The optical beam scanning device according to claim 10, wherein the support member is formed by only perforation processing plate material.

24. The optical beam scanning device according to claim 11, wherein the support member is formed by only perforation processing plate material.

25. The optical beam scanning device according to claim 12, wherein the support member is formed by only perforation processing plate material.

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